

THE IMPORTANCE OF METEORITE COLLECTIONS TO SAMPLE RETURN MISSIONS: PAST, PRESENT, AND FUTURE CONSIDERATIONS

Welzenbach, L.C.¹, McCoy, T.J.¹ & Glavin, D. P.², Dworkin, J. P.², & Abell, P.A.³

¹Smithsonian Institution (NMNH, 10th and Constitution Ave, NW, Washington DC 20560 USA)

²NASA Goddard Space Flight Center (8800 Greenbelt Road, Greenbelt, MD 20770, USA)

³NASA Johnson Space Center (JSC-KR 111, NASA Rd. 1, Houston, TX 77058, USA)

e-mail:welzenbl@si.edu

While much of the scientific community's current attention is drawn to sample return missions, it is the existing meteorite and cosmic dust collections that both provide the paradigms to be tested by these missions and the context for interpreting the results. Recent sample returns from the Stardust and Hayabusa missions provided us with new materials and insights about our Solar System history and processes. As an example, Stardust sampled CAIs among the population of cometary grains, requiring extensive – and unexpected – radial mixing in the early solar nebula. This finding would not have been possible, however, without extensive studies of meteoritic CAIs that established their high-temperature, inner Solar System formation. Samples returned by Stardust also revealed the first evidence of a cometary amino acid, a discovery that would not have been possible with current *in situ* flight instrument technology. The Hayabusa mission provided the final evidence linking ordinary chondrites and S asteroids, a hypothesis that developed from centuries of collection and laboratory and ground-based telescopic studies. In addition to these scientific findings, studies of existing meteorite collections have defined and refined the analytical techniques essential to studying returned samples. As an example, the fortuitous fall of the Allende CV3 and Murchison CM2 chondrites within months before the return of Apollo samples allowed testing of new state-of-the-art analytical facilities. The results of those studies not only prepared us to better study lunar materials, but unanticipated discoveries changed many of our concepts about the earliest history and processes of the solar nebula. This synergy between existing collections and future space exploration is certainly not limited to sample return missions. Laboratory studies confirmed the existence of meteorites from Mars and raised the provocative possibility of preservation of ancient microbial life. The laboratory studies in turn led to a new wave of Mars exploration that ultimately could lead to sample return focused on evidence for past or present life. This partnership between collections and missions will be increasingly important in the coming decades as we discover new questions to be addressed and identify targets for both robotic and human exploration. Nowhere is this more true than in the ultimate search for the abiotic and biotic processes that produced life. Existing collections also provide the essential materials for developing and testing new analytical schemes to detect the rare markers of life and distinguish them from abiotic processes. Large collections of meteorites and the new types being identified within these collections, which come to us at a fraction of the cost of a sample return mission, will continue to shape the objectives of future missions and provide new ways of interpreting returned samples.

Key-words: Meteorites, Sample return, Murchison